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Surgical treatment of horizontal strabismus

Tratamento cirúrgico dos estrabismos horizontais

Tratamiento quirúrgico del estrabismo horizontal

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ABSTRACT

This article presents the experience of its authors regarding the basic principles that guide them in the surgical treatment of horizontal strabismus. It addresses subjects such as the surgical classification of strabismus, minimal conditions for surgical indication, ideal age for surgery, principles of operating on the extraocular musculature, muscle response to shortening and recession, and other aspects relevant to a successful treatment of this type of oculomotor disorders.

Keywords:
Strabismus;
Surgery;
Orthoptics;
Esotropia;
Exotropia

RESUMO

Este artigo apresenta a experiência dos seus autores, relativas aos princípios básicos que os norteiam no tratamento cirúrgico dos estrabismos horizontais. Trata de assuntos como a classificação cirúrgica do estrabismo, condições mínimas para a indicação cirúrgica, idade cirúrgica ideal, princípios de atuação sobre a musculatura extraocular, resposta muscular frente aos encurtamentos e recuos e outros aspectos relevantes para o sucesso terapêutico desse tipo de distúrbio oculomotor.

Palavras-Chave:
Estrabismo;
Cirurgia;
Ortóptica;
Esotropia;
Exotropia

RESUMEN

Este artículo presenta la experiencia de sus autores, relativas a los principios básicos que los nortean en el tratamiento quirúrgico de los estrabismos horizontales. Trata de temas como la clasificación quirúrgica del estrabismo, condiciones mínimas para la recomendación quirúrgica, edad quirúrgica ideal, principios de actuación sobre la musculatura extraocular, respuesta muscular frente a los acortamientos y retrocesos, entre otros aspectos relevantes para el éxito terapéutico de ese tipo de disturbio oculomotor.

Palabras Clave:
Estrabismo;
Cirurgía;
Ortóptica;
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INTRODUCTION

Strabismus is an eye condition that, apart from the esthetic aspect, is often associated with the visual impairment of the deviated eye known as strabismic amblyopia. Both conditions tend to limit the emotional and professional development of the person affected. Given that in most cases, the treatment involves surgery and because it is a subject of which the frequency of mention in the literature is decreasing, the objective of this publication is to report our experience of the basic principles that guide us in the surgical treatment of horizontal strabismus. Vertical deviations are less common and their treatment is more complex. Therefore, they will not be addressed in this article. We hope that this publication will rekindle interest in oculomotricity among ophthalmologists, particularly in regions where no specialists are available.

Surgical classification of strabismus

The goal of surgical treatment of strabismus is to correct ocular misalignment, but the outcome depends on the potential for the use of binocular vision. As a result, surgeries are classified as esthetic or functional. The former are those in which binocular cooperation between the eyes is not expected. They are purely cosmetic interventions associated with irreversible amblyopia and permanent defects in the capture and conduction of the light stimulus to the visual cortex. The latter are those in which some form of postoperative binocular collaboration is expected.

In esthetic strabismus procedures, the realignment of the eyes depends exclusively on the surgery. Any residual deviation, however small, will not be compensated because there is no binocular collaboration. Because the extraocular muscles do not have proprioceptors, the only stimulus for ocular alignment is the possibility of forming a single visual impression from the images of both eyes. In the absence of this alternative, there is no assurance that a residual deviation from the surgery will be neutralized by fusional movements. There is also no assurance that the surgical outcome will remain stable. These aspects depend on the balance of forces among the muscles operated on. If this balance is tipped to one side, the eye will inevitably be deviated to that side. In functional strabismus procedures, fusion tends to compensate small residual deviations and keep the eyes permanently aligned. In some cases, a microstrabismus that allows perifoveal fusion remains because it is very minor. This sensory adaptation maintains the stability of the surgical outcome, although it does not prevent amblyopia.

Minimum conditions for surgical indication

For surgery to be indicated for a patient with strabismus, certain requirements must be met. These vary depending on whether the strabismus is esthetic or functional. In esthetic strabismus, surgery should only be performed after obtaining reliable and stable measurements of the deviation and a complete diagnosis of the motor profile. In functional strabismus, in addition to the previous requirements, the views of both eyes must be equalized and the deviation must be alternating, without any fixation preference. Identical views facilitate bifoveal fusion, which in turn stabilizes the surgical outcome. However, there are cases where alternation cannot be achieved even with equalized views. In these cases, surgery is performed without this prerequisite.

Importance of preoperative occlusive treatment

The ocular position is dictated by the balance of the active forces of the extraocular muscles and passive viscoelastic forces of their tendons, fasciae, and ligaments.[1] In strabismus, because one eye is preferred, the other spends more time being deviated. The recalcitrant position of the deviated eye leads to shortening of its periocular collagen structures. This not only restricts eye movement but also consolidates the deviation. Occlusion of the fixating eye (FE) helps correct both amblyopia and tissue contraction. The alternation of the deviation induced by the occlusion is important because it indicates that the views have equalized and that the mechanical limitations have been corrected. The occlusion should be directly applied on the eyelid daily during the entire waking period. The occlusion regimen is based on the patient’s age and may be changed over the course of the treatment. For up to 1 year of age, we occlude FE for 1 day and the amblyopic eye (AE) for 1 day; for 2 years of age, two days FE/1 day AE; and so on up to 6 years of age, wherein the occlusion regimen is 6 days FE/1 day AE. From this age on, the occlusion tends to be applied exclusively to the FE until amblyopia is cured. This regimen is modified according to the visual behavior of both eyes during the treatment.

When the strabismus procedure is cosmetic, it makes no sense to penalize the patient by occluding FE because it is the only one that they can see with. We tried to offset the lack of occlusive treatment with the surgical release of mechanical contractures, paying special attention to the conjunctiva. It is not uncommon for an area of the sclera to remain uncovered where the conjunctiva is retracted.

Surgical age

In functional endotropy, surgery should be performed as soon as possible, provided the minimum requirements are satisfied. This generally occurs between 1 and 2 years of age. In exotropy, it is best to delay surgery for as long as possible, resorting to all possible orthoptic treatments such as antisuppression exercises, partial occlusion of the dominant eye, and negative lenses. For some reason that is still not well understood, exodeviations tend to cause a lesser degree of amblyopia than endodeviations. As a result, surgery that transforms an exotropy into an endotropy is less desirable when the patient is younger. If the strabismus is esthetic, the surgical opportunity becomes more of a family decision, keeping in mind that the outcomes tend to be unstable.

Which eye to operate on?

When the surgery involves both eyes, the ideal approach is to perform a major part of it on the dominant eye. Apparently, this results in more predictable and stable outcomes. The logic is that healthy muscles under strict brain control respond better to surgery. If the procedure is to be performed on only one eye, this rationale applies to functional strabismus procedures. In esthetic ones, the benefits do not outweigh the risk of operating on the eye with better vision.

Destabilizers of surgical outcomes

There are conditions that increase the unpredictability of the surgical outcomes in horizontal strabismus: low visual acuity, mechanical contractures, “A”- and “V”-shaped variations, vertical deviations, and muscular paralysis. The first two have already been addressed. The next two conditions destabilize horizontal functional control. Paralysis responds poorly to muscle shortening because the induced viscoelastic tension is proportional to muscle mass. Because poorly innervated muscles have little mass, the results are poor. All these factors must be taken into account when planning for strabismus surgery.

Anesthesia

Ideally, conventional strabismus surgery should be performed under general anesthesia. In adults, when the procedure is uniocular, anesthesia may be peribulbar or even topical using anesthetic eye drops. In the latter case, it is possible to apply the readjustable suture technique, monitoring ocular alignment using the cover test and a fixation light on the surgical table itself. To prevent pain, the muscles should be slowly and gradually tractioned.

Principles of operating on the extraocular muscles

Operating on the extraocular muscles follows several principles that facilitate surgical planning and make the procedure less risky. However, they should not be considered as hard and fast rules. These principles are as follows:

1. Pure muscle resections tend to lose their effect over time.
2. Muscle recessions tend to be more effective than resections.
3. Dual recession of the medial rectus tends to correct short-sightedness more than long-sightedness.
4. Dual recession of the lateral rectus tends to correct long-sightedness more than short-sightedness.
5. Recessions of the medial rectus less than 3 mm tend to be ineffective.
6. Recessions of the lateral rectus less than 5 mm tend to be ineffective.
7. Resections of less than 5 mm tend to be ineffective.
8. Do not recess the medial rectus more than 5 mm (for non-specialists in strabismus).
9. Do not recess the lateral rectus more than 9 mm (for non-specialists in strabismus).
10. Do not recess the vertical rectus more than 5 mm (for non-specialists in strabismus).
11. Do not resect the horizontal recti more than 10 mm.

12. Do not resect the vertical recti more than 6 mm.
13. Never operate on more than three rectus muscles of the same eye during the same surgery.
14. In patients over 50 years of age, you should not operate on more than two recti of the same eye during the same surgery.

Surgical calculations in horizontal strabismus

The three surgeries most commonly used in the treatment of horizontal strabismus are agonist muscle recession, shortening of the antagonist muscle (resection or plication), and vertical transposition of the muscle insertions. These surgeries can be performed alone or in combination. The response of the deviation to these procedures depends on each surgeon's technique, especially pertaining to how they measure distances during the operation. Below, we present some numbers that should be interpreted only as rough calculation references. They are the results of a retrospective study conducted at our service 30 years ago comprising a sample of 400 surgeries, divided equally between endotropies and exotropies. We extracted the following values from this study, with the angles of deviation expressed in prism diopters (PD):

1. Isolated recession of the medial rectus muscle corrects 3.0 PD per mm.
2. Isolated resection of the lateral rectus muscle corrects 2.0 PD per mm.
3. Isolated recession of the lateral rectus muscle corrects 1.5 PD per mm.
4. Isolated resection of the medial rectus muscle corrects 2.0 PD per mm.
5. Recession of the medial rectus + resection of the lateral rectus of the same eye have a combined effect of 33%.
6. Recession of the lateral rectus + resection of the medial rectus of the same eye have a combined effect of 25%.

Vertical displacements of the horizontal recti

In surgeries on the horizontal recti, following recession or resection, the muscle insertions can be sutured either in alignment with the original or as vertically displaced insertions. The vertical displacement serves to correct associated vertical deviations or “A”- or “V”-shaped variations.

When displacing the medial and lateral recti upward, the eye is raised, and when displacing them downward, the eye is lowered. The displacement varies from 5 to 10 mm. By displacing both medial recti to the apex of the “A”-shaped variation, the “A” shape is corrected. By displacing both medial recti to the apex of the “V”-shaped variation, the “V” shape is corrected. By displacing both of the lateral recti to the base of the “A”-shaped variation, the “A” shape is corrected. By displacing both of the lateral recti to the base the "V"-shaped variation, the “V” shape is corrected. Most of the vertical displacements that we perform are 6 mm.

Insertion displacement is generally indicated for esthetic strabismus procedures. In functional ones, the oculomotricity specialist determines the muscles directly responsible for vertical deviations or for letter-shaped variations and directly operates on them.

Surgical importance of the conjunctiva

Regardless of the type of strabismus, when the conjunctiva is shrunken, it must be recessed, leaving the area of the sclera bare. Shortening of the conjunctiva is manifested by a limitation in the eye movement in the field opposite the tissue contraction. This is tested during surgery with forceps, gripping the limbus in a position diametrically opposite to the rotation that the surgeon wishes to give the eye. The test is considered positive when mechanical restriction to the passive rotation of the eye is detected. Particular attention should be paid to the conjunctival sutures so as to not create very obvious scarring. The patient tends to evaluate treatment success not by function but by esthetics.

Surgical Outcome

The surgery may result in ocular alignment with bifoveal fusion. In this case, it is sufficient to monitor the vision until the end of the visual maturation period. It may result in microstrabismus (≤5 PD) with parafoveal fusion. The deviation tends to be stable, but because it still exists, FE should be occluded daily on a part-time basis, and vision should be rigorously monitored. The outcome may be a small-angle strabismus (≤15 PD), with excellent esthetics and perfect fixation alternation. In this case, refraction under cycloplegia,[2] should be reviewed hoping that a suitable change in the accommodative force will reduce the deviation, facilitating fusion. The main objective is to

maintain vision and alternation until the end of the treatment. Residual strabismus greater than 15 PD, and therefore obvious, may occur. In this situation, the patient must be prepared for another surgery, which may continue for more than a year, once again respecting the minimum criteria for the indication of surgical treatment. There is a range of possibilities beyond those described, but the general principle is that if a deviation remains during the visual maturation phase, a possibility of recurrence of amblyopia and regression of the motor profile exists. If the prognosis of the strabismus is esthetic, the result will be determined on the final appearance.

It is important to explain to the patient and their family that even under the best possible preoperative conditions, there is a chance that the desired outcome will only be achieved with two or even three surgeries, that the treatment of functional strabismus only ends after the conclusion of visual maturation when vision stabilizes, and that the deviation may re-emerge at any time of life, particularly if it is of the esthetic type.

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